

REMARKS

Below, the applicant's comments are preceded by related remarks of the examiner set forth in small bold type.

2. Claims 27-31, 42, and 43 are rejected under 35 U.S.C. 102(b) as being anticipated by Jucha et al, US Patent 4,874,723.

Jucha et al teaches a plasma etching apparatus that includes: a chamber 1306; a support 1320 for supporting a wafer (plate) 48; a first high frequency source attached to an electrode 1314; a second high frequency source attached to a remote plasma generator 1326; an inlet structure 1304, 1322; mass flow controllers connected to each gas inlet to control the amount and concentration of the gases supplied to the chamber and controlled by a control system 206. Jucha et al also teaches forming mixed gas plasma containing SF₆ and CF₄. (Entire document, specifically, figure 32, column 51 lines 36-41; and column 64 line 48-51)

Claims 27-31

Jucha does not disclose or suggest that the first and second plasmas have a specified ratio such that a combination of the first and second plasmas etch a substrate in which the rate of etching across the substrate is within 1% of the rate of etching at a central portion of the substrate, as recited in amended claim 27.

While Jucha discloses the use of CF₄ and SF₆ for generating plasmas, Jucha does not disclose or suggest that the ratio of CF₄ and SF₆ plasmas is related in any way to the uniformity of etching rate across a substrate.

The examiner points to column 51, lines 36-41 and column 64, lines 48-51 of Jucha. However, these sections merely mention the use of SF₆ and CF₄ gases, and do not mention how the ratio of CF₄ and SF₆ affects the uniformity of etching rate across a substrate.

Jucha discloses that at a particular operating condition, a negative etch bias of approximately 0.15-0.2 micron can be achieved (col. 51, lines 46-47). Jucha also discloses that by using fluorine and helium with remote plasma and in situ plasma, the etch rates can be improved to have be twice the sum of the remote and in situ plasmas alone (col. 64, lines 40-50). However, neither the negative etch bias nor the improvement in etch rate discloses or suggests that when the first and second plasmas have a specified ratio, the rate of etching across the substrate can be within 1% of the rate of etching at a central portion of the substrate.

Claims 28-31 are patentable for at least the same reasons as claim 27. Moreover, these claims add additional distinctive features. For example, claim 31 recites "the first plasma and the second plasma have a specified ratio so that a sum of the positive ions in the first plasma and the positive ions in the second plasma is substantially uniform across a substantial portion of the substrate." Jucha does not mention anything about a sum of a positive ions in a first plasma and a positive ions in a second plasma, so Jucha could not have disclosed or suggested that the sum is substantially uniform across a substantial portion of a substrate. Jucha does not suggest at least these features of claim 31.

Claims 42 and 43

Jucha does not disclose or suggest that his etching apparatus can achieve a substantially uniform etching across a surface to be etched in a chamber. Without the benefit of the applicant's invention, there is not suggestion that Jucha's controller can be configured to cause substantially uniform etching across the surface to be etched.

The applicant notes that claim 42 does not merely recite a controller. The controller recited in claim 42 is configured in a particular way -- the controller is configured to control relative amounts of two different types of plasma etchants in the chamber to cause substantially uniform etching across a surface to be etched in the chamber, in which the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface. Although Jucha's etching apparatus has a controller, Jucha does not disclose or suggest that the controller is configured in the same way as recited in claim 42, or that the controller is capable of being configured in the same way as recited in claim 42. Therefore, Jucha could not have anticipated claim 42.

Claim 43 is patentable for at least similar reasons as claim 42.

3. Claims 24 and 25 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Jucha et al, US Patent 4,874,723.

Jucha et al teaches a plasma etching apparatus that includes: a chamber 1306; a support 1320 for supporting a wafer (plate) 48; a first high frequency source attached to an electrode 1314; a second high frequency source attached to a remote plasma

generator 1326; an inlet structure 1304, 1322; mass flow controllers connected to each gas inlet to control the amount and concentration of the gases supplied to the chamber and controlled by a control system 206. Jucha et al also teaches forming mixed gas plasma containing SF₆ and CF₄. (Entire document, specifically, figure 32, column 51 lines 36-41 ; and column 64 line 48-51)

The specific type of substrate (i.e. quartz) worked on is an intended use the apparatus. This rejection is based on the fact that the apparatus structure of Hongoh [sic] has the inherent capability of working on (i.e. processing) a quartz substrate, as intended by the Applicant. It has also been held that "Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim." Ex parte Thibault, 164 USPQ 666, 667 (Bd. App. 1969). Furthermore, "Inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims." In re Young, 25 USPQ 69 (CCPA 1935) (as restated in In re Otto, 136 USPQ 458, 459 (CCPA 1963).

Alternately, if the specific type of substrate treated is held not to be an inherent intended use of the apparatus of Jucha et al, then it would had been obvious to one of ordinary skill in the art at the time of the invention was made to etch a quartz substrate using SF₆ and CF₄.

Jucha does not disclose or suggest a first plasma, a second plasma, and a quartz plate supported within the chamber, in which the first and second plasmas have a specified ratio such that a combination of the first and second plasmas etch the quartz plate in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate, as recited in amended claim 24.

Jucha does not disclose or suggest etching a quartz plate, or that his etching apparatus is inherently capable of etching a quartz plate, in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate. For example, FIG. 30A of Jucha shows that the etching rate for etching photoresist is not uniform across the wafer, the difference in etching rate across the wafer varying substantially greater than 1% of the etching rate at the central portion of the wafer.

A quartz plate does not have a stop layer, so if Jucha's apparatus were used to etch the quartz plate, without the benefit of the applicant's invention, different portions of the quartz plate would be etched at different rates and be etched to different depths. Jucha does not disclose or suggest that it is useful to etch a quartz plate this way. Thus, etching a quartz plate could not have been an intended use of Jucha's etching apparatus.

Moreover, it would not have been obvious to a person skilled in the art to etch a quartz plate using CF₄ and SF₆ in the etching apparatus of Jucha. When Jucha's etching apparatus is

used to etch photoresist on a wafer, the etching rate is not uniform across the wafer (see FIG. 30A of Jucha). Without the benefit of the applicant's invention, it would not have been obvious to a person skilled in the art that adjusting the ratio of CF₄ and SF₆ in Jucha's etching apparatus would affect uniformity of etching across a wafer or a quartz plate. Therefore, it would not have been obvious to a person skilled in the art to use Jucha's etching apparatus to etch a quartz plate, in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate.

Claim 25 is patentable for at least the same reasons as claim 24.

4. Claims 24, 25, 27-31, 42, and 43 are rejected under 35 U.S.C. 102(a) as being clearly anticipated by Applicants disclosed prior art.

After describing the apparatus found in Figure 1 the applicant further discloses that "A suitable plasma chamber apparatus is available as model VRL-ME-II-M-QTZ from Unaxis, St. Petersburg, Florida." (See the specification page 4 lines 13-15) The specific process performed on the specific type of substrate is an intended use of the apparatus. The apparatus disclosed by the Applicant can perform the desired process on the desired substrate as indicated by the Applicant.

Prior to applicant's invention, the prior art plasma chamber described in the applicant's specification was not used to etch a substrate or quartz plate in which the rate of etching across quartz plate is within 1% of the rate of etching at the central portion of the quartz plate, as recited in claim 24. Prior to the applicant's invention, it was not known that the prior art plasma chamber could achieve a uniform etching rate when etching a quartz plate. Prior to the applicant's invention, etching a quartz plate in which the etching rate across the quartz plate is within 1% of the rate of etching at the central portion of the substrate or quartz plate could not have been an intended use of the prior art plasma chamber. Therefore, claim 24 could not have been anticipated by the prior art plasma chamber.

Claim 25 is patentable for at least the same reasons as claim 24.

Claim 27 is patentable for at least similar reasons as claim 24.

Claims 28-31 are patentable for at last the same reasons as claim 27.

Because, without the applicant's invention, it was not known that the prior art plasma chamber could achieve a uniform etching rate when etching a surface, the prior art plasma

chamber could not have anticipated a controller configured to control relative amounts of two different types of plasma etchants to cause substantially uniform etching across a surface to be etched in the chamber, in which the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface, as recited in claim 42.

Claim 43 is patentable for at least similar reasons as claim 42.

5. Claims 24, 25, 27-31, 42 and 43 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Hongoh, US Patent 6,343,565 B1.

Hongoh teaches a plasma processing apparatus that includes: a chamber S; a support 24 for supporting a wafer (plate) W; a high frequency source 76; and an inlet structure comprising a first gas supply 54 connected to a first inlet 38 via a first flow controller 46, and a second gas supply 56 connected to a second inlet 40 via a second flow controller 48. (Figure 5)

The particular type of gas used to form a specific plasma is a process limitation rather than an apparatus limitation, and the recitation of a particular type of plasma does not so limit an apparatus claim, see *In re Casey*, 152 USPQ 235; *In re Rishoi*, 94 USPQ 71; *In re Young*, 25 USPQ 69; *In re Dulberg*, 129 USPQ 348; *Ex parte Thibault*, 164 USPQ 666; and *Ex parte Masham*, 2 USPQ2d 1647. This rejection is based on the fact that the apparatus of Hongoh has the inherent capability of supplying the desired gases to form the desired plasma intended by the Applicant. Furthermore, It has been held that: claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. *In re Danley*, 120 USPQ 528, 531, (CCPQ 1959); "Apparatus claims cover what a device is, not what a device does" (Emphasis in original) *Hewlett-Packard Co. V. Bausch & Lomb Inc.*, 15 USPQ2d 1525, 1528 (Fed. Cir. 1990); and a claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus " if the prior art apparatus teaches all the structural limitations of the claim *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987). Also see MPEP 2114.

The specific type of substrate (i.e. quartz) worked on (i.e. etched) is an intended use of the apparatus. This rejection is based on the fact that the apparatus structure of Hongoh has the inherent capability of working on (i.e. processing) a quartz substrate, as intended by the Applicant. It has also been held that "Expressions relating the apparatus to contents thereof during an intended operation are of no significance in determining patentability of the apparatus claim." *Ex parte Thibault*, 164 USPQ 666, 667 (Bd. App. 1969). Furthermore, "Inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims " *In re Young*, 25 USPQ 69 (CCPA 1935) (as restated in *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

The only structural limitations claimed is a chamber in which a plasma containing multiple gases is formed and a flow controller to control the flow of the plasma gases. Hongoh teaches such a chamber.

Claims 29-31 deal directly with how the apparatus is used. The limitations are specifically connected to the type of gases supplied and the specific mixture of these gases. The Examiner can find no structure taught by the applicant that directs or controls the gases to achieve these process limitations (i.e., showerhead, baffle) other

than the generic gas inlet system. In fact, the only way to achieve these process limitations taught by the Applicant is to use known mass flow controllers to control the mixture or ratio of the gases delivered to a known apparatus.

Alternately, if the type of plasma formed in the chamber and type of substrate treated are held not to be inherent in the functions of the apparatus of Hongoh, it would have been obvious to one of ordinary skill in the art at the time the invention was made to supply the desired gases in the desired amounts to the apparatus of Hongoh to form the desired plasma and to use the desired plasma to treat the desired substrate.

...

10. Applicant's arguments filed June 20, 2005 have been fully considered but they are not persuasive. All of the arguments are based on the Applicant's assertion that the claimed plasma and quartz plate are structural elements, and not contents of an apparatus during the operation of the apparatus or materials worked on by the apparatus, the Examiner disagrees.

The formation of a plasma is the very purpose of a plasma apparatus. The apparatus performs work on the gas through the application of energy and forms the plasma. The plasma will only exist while the apparatus is in operation. Therefore, the limitation in claims 24 and 27 requiring a chamber having a specific type of plasma is an expression relating the apparatus to contents thereof during an intended operation and as directed by the MPEP 2115 should be of no significance in determining patentability of the apparatus claims, as held in *Ex parte Thibault*, 164 USPQ 666, 667 (Bd. App. 1969).

Likewise, the quartz is supported in the chamber and etched by the plasma formed by the apparatus in the chamber. Therefore, the quartz plate is being worked on by the apparatus, as held in *In re Young*, 75 F.2d 996, 25 USPQ 69 (CCPA 1935) (as restated in *In re Otto*, 312 F.2d 937, 136 USPQ 458, 459 (CCPA 1963) inclusion of material or article worked upon by a structure being claimed does not impart patentability to the claims.

What is missing in Jucha is also not disclosed or suggested in Hongoh. Hongoh discloses "a plasma processing apparatus which processes a wafer for producing a semiconductor device ..." (col. 1, lines 9-10), but does not disclose etching a quartz plate, or uniform etching across a substrate. Claims 24, 25, 27-31, 42, and 43 are patentable over Hongoh for at least similar reasons that those claims are patentable over Jucha.

Moreover, the claims can be anticipated by Hongoh only if "each and every element as set forth in the claims is found, either expressly or inherently described." Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631 (Fed. Cir. 1987). See also MPEP section 2131 on anticipation.

Regarding claims 24 and 25, Hongoh does not expressly or inherently disclose a quartz plate, as recited in claim 24. Hongoh also does not expressly or inherently disclose first and second plasmas that have a specified ratio such that a combination of the first and second

plasmas etch the quartz plate in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate, as recited in claim 24.

Regarding claims 27-31, Hongoh does not expressly or inherently disclose a first plasma having more negative ions than electrons, a second plasma in the chamber having more electrons than negative ions, the amounts of the first and second plasmas having a specified ratio such that a combination of the first and second plasmas etch the substrate in the chamber in which the rate of etching across the substrate is within 1% of the rate of etching at a central portion of the substrate, as recited in claim 27.

Regarding claim 42, Hongoh does not expressly or inherently disclose a controller configured to control relative amounts of two different types of plasma etchants in a chamber to cause substantially uniform etching across a surface to be etched in the chamber, in which the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface.

Regarding claim 43, Hongoh does not expressly or inherently disclose a control mechanism set to control a sum of positive ions in a first plasma and a second plasma to be substantially uniform across central and peripheral regions of a surface to be etched in the chamber, such that the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface.

Because Hongoh does not expressly or inherently disclose each and every limitation of claims 24, 25, 27-31, 42, and 43, Hongoh could not have anticipated those claims.

The applicant disagrees with the examiner's interpretation of In re Casey, 152 USPQ 235, In re Rishoi, 94 USPQ 71, In re Young, 25 USPQ 69, In re Dulberg, 129 USPQ 348, Ex parte Thibault, 164 USPQ 666, Ex parte Masham, 2 USPQ 2d 1647, and Hewlett-Packard Co. V. Bausch & Lomb Inc., 15 USPQ2d 1525, to support his assertion that the recitation of a quartz plate or the particular types of plasmas do not limit an apparatus claim and should be given no significance in determining patentability of the claim. In the applicant's response dated May 16, 2005, the applicant has distinguished each of the cases cited by the examiner.

The applicant contends that the cases (In re Casey, In re Rishoi, In re Young, In re Dulberg, Ex parte Thibault, Ex parte Masham, and Hewlett-Packard Co. V. Bausch & Lomb Inc.) cited by the examiner do not support the examiner's arguments. The examiner has quoted the cases without considering their relevant context.

7. **Claims 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jucha et al, 4,874,723 in view of Oda et al, Journal of Vacuum Science & Technology (Nov.-Dec. 1996) vol. 14, no. 6, p. 4366-70 "X-ray mask fabrication technology for 0.1 μ m very large scale integrated circuits"**

Jucha et al was discussed above.

Jucha et al differs from the present invention in that Jucha et al does not teach etching a quartz substrate with SF₆ and CF₄.

Oda et al teaches etching a quartz substrate with SF₆ and CF₄. (See section III. B. on pages 4367-67)

The motivation for etching a quartz substrate with a mixture SF₆ and CF₄ in the apparatus of Jucha et al is to provide an etching apparatus in which to carry out the etching process taught by Oda et al.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the etching method of Oda et al in the apparatus of Jucha et al.

As discussed above, Jucha does not disclose or suggest a quartz plate. Jucha also does not disclose or suggest first and second plasmas that have a specified ratio such that a combination of the first and second plasmas etch the quartz plate in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate, as recited in claim 24.

What is missing in Jucha is also not disclosed or suggested by Oda. In Oda, an SiO₂ film is deposited as an etching mask for an absorber after SiN and Ta are deposited on a Si wafer (page 4366, section B). Although Oda discloses etching the SiO₂ film, the SiO₂ film is not a quartz plate. A quartz plate does not have a stop layer, so the etching rate across the quartz plate has to be uniform in order to achieve uniform etching depth. By comparison, in Oda, when the SiO₂ film is etched using CF₄ and SF₆, etching of the SiO₂ film stops at the Ta layer. The etching depth of the SiO₂ film is uniform (the exposed portions of the SiO₂ film are etched away) even if the etching rate is not uniform across the wafer. The Ta layer is then etched using ECR ion stream etching with Cl₂ and O₂ (page 4366, section B). Oda does not disclose an

etching apparatus that achieves uniform etching across a substrate, and does not disclose or suggest an apparatus suitable for etching a quartz plate. Therefore, Oda does not disclose or suggest, and would not have made obvious, a quartz plate supported within the chamber.

While Oda discloses the use of SF₆ and CF₄, Oda does not disclose or suggest how a ratio of the SF₆ and CF₄ plasmas would affect uniformity of etching rate. Oda does not disclose or suggest, and would not have made obvious, first and second plasmas that have a specified ratio such that a combination of the first and second plasmas etch the quartz plate in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate. Thus claim 24 would not have been made obvious by Jucha and Oda.

Claim 25 is patentable for at least the same reasons as claim 24.

8. Claims 24, 25, 27-31, 42, and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hongoh, 6,343,565 B1 in view of Oda et al, Journal of Vacuum Science & Technology (Nov.-Dec. 1996) vol. 14, no. 6, p 4366-70 "X-ray mask fabrication technology for 0.1 μ m very large scale integrated circuits".

Hongoh was discussed above.

Hongoh differs from the present invention in that Hongoh does not teach etching a quartz substrate with SF₆ and CF₄.

Oda et al teaches etching a quartz substrate with SF₆ and CF₄. (See section III.

B. on pages 4367-67)

The motivation for etching a quartz substrate with a mixture SF₆ and CF₄ in the apparatus of Hongoh is to provide an etching apparatus in which to carry out the etching process taught by Oda et al.

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the etching method of Oda et al in the apparatus of Hongoh.

As discussed above, Hongoh does not disclose or suggest a quartz plate. Hongoh also does not disclose or suggest first and second plasmas that have a specified ratio such that a combination of the first and second plasmas etch the quartz plate in which the rate of etching across the quartz plate is within 1% of the rate of etching at the central portion of the quartz plate, as recited in claim 24. As discussed above, what is missing in Hongoh is also not disclosed or suggested in Oda. Thus claim 24 would not have been made obvious by Hongoh and Oda.

Claim 25 is patentable for at least the same reasons as claim 24.

Neither Hongoh nor Oda discloses or suggests first and second plasmas having a specified ratio such that a combination of the first and second plasmas etch the substrate in the chamber in which the rate of etching across the substrate is within 1% of the rate of etching at a central portion of the substrate, as recited in claim 27. Neither Hongoh nor Oda discusses the ratio of first and second plasmas, and neither discusses the uniformity of etching rate across a substrate. Thus, claim 27 would not have been made obvious by Hongoh and Oda.

Claims 28-31 are patentable for at least the same reasons as claim 27.

Although the etching apparatus of Hongoh and Oda may inherently have a controller, neither Hongoh nor Oda discloses or suggests that the controller be configured to control relative amounts of two different types of plasma etchants in the chamber to cause substantially uniform etching across a surface to be etched in the chamber, in which the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface, as recited in claim 42. Thus, claim 42 would not have been made obvious by Hongoh and Oda.

Although the etching apparatus of Hongoh and Oda may inherently have a control mechanism, neither Hongoh nor Oda discloses or suggests a control mechanism set to control a sum of positive ions in a first plasma and a second plasma to be substantially uniform across central and peripheral regions of a surface to be etched in the chamber, such that the rate of etching at a peripheral portion of the surface is within 1% of the rate of etching at a central portion of the surface, as recited in claim 42. Thus, claim 42 would not have been made obvious by Hongoh and Oda.

Any circumstance in which the applicant has addressed certain comments of the examiner does not mean that the applicant concedes other comments of the examiner. Any circumstance in which the applicant has made arguments for the patentability of some claims does not mean that there are not other good reasons for patentability of those claims and other claims. Any circumstance in which the applicant has amended a claim does not mean that the applicant concedes any of the examiner's positions with respect to that claim or other claims.

Applicant : Y. Long He et al.
Serial No. : 10/718,832
Filed : November 21, 2003
Page : 16 of 16

Attorney Docket: 10559-583002 / P12764D

Enclosed is a \$450 check for the Petition for Extension of Time fee. Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,

Date: 2/13/2006

Rex I. Huang
Rex I. Huang
Reg. No. 57,661

Fish & Richardson P.C.
225 Franklin Street
Boston, MA 02110
Telephone: (617) 542-5070
Facsimile: (617) 542-8906

21234825.doc